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TAKING COMPLETE RECEIVER PERFORMANCE DATA

At one time, the belief was partially justified that only engineers should bother to take performance data on radio receivers Today, however, home and communications receivers of competitive manufacture follow many varied designs and performance standards so that good practice favors keeping a case history of each receiver that goes through a service shop. The foundation for such a case history is a complete performance test which yields important information when the receiver is returned for subsequent conditioning. Furthermore, a performance test is imperative before and after an overhaul, in order to determine the benefit of repairs and adjustments. It also should be a part of the serviceman's trouble-shooting procedure, and certainly should follow each major repair job. Once the test procedure has been mastered, the service engineer will be able to handle the operations quickly in routine, and engineer and client will benefit mutually from the quantitative information obtained.

Recommended Test Program

We recommend that the serviceman check the following characteristics of an a. m.-type superheterodyne receiver in the order listed:

(1) Audio gain and sensitivity
(2) Audio power output
(3) Fidelity (frequency response) of the audio channel
(4) I. F. gain
(5) I. F. bandwidth
(6) Conversion gain
(7) Selectivity
(8) Sensitivity
(9) Fidelity of entire receiver
(10) Noise or hum level

The order of the above tests progresses backward from the loudspeaker to the antenna terminals. This is a logical procedure which serves to reveal performance defects at the proper point in the program and thus to isolate them. For instance, test 3 may show that the audio channel, as designed and manufactured, has poor fidelity. With this fact established, the operator then will not needlessly indict the front end and i. f. amplifier of the receiver if the same poor frequency response is noted in test 9. On the contrary, if test 9 had been made first, confusion would exist as to first point at which the poor fidelity appeared.

Required Instruments

The instruments required for taking complete receiver performance data may be found in any well-equipped service shop. They are (1) r. f. test oscillator or signal generator, (2) variable-frequency audio test oscillator, and (3) a. c. vacuum-tube voltmeter. In addition to these instruments, a dummy antenna (see Figure 1) must be constructed by the reader. Also, a power-type load resistor will be needed for connection in place of the loudspeaker voice coil. Following is a discussion of the required characteristics of the instruments.

R. F. Test Oscillator. This signal generator must be internally modulated 30% at 400 cycles and (for test 9) should have a jack or other provision for applying an external modulating signal from an audio test oscillator.

An important requirement is that the output attenuator must be calibrated to read the output signal strength in microvolts. Several manufactured service oscillators (such as the Jackson instruments, McMurdo Silver Model 906, and Clough-Brengle Microvolter) have direct-reading microvolt attenuators. Oscillators which are not calibrated in

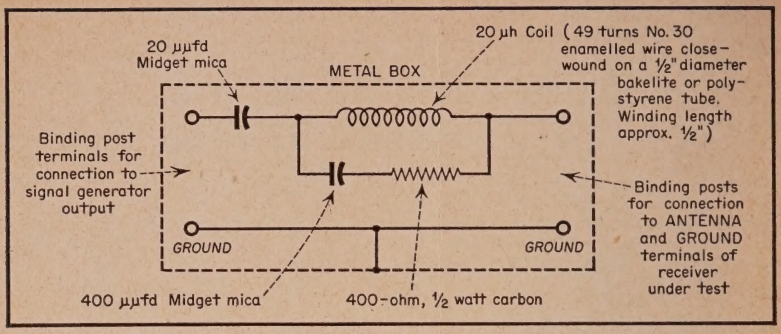
20 µµfd
Midget mica
METAL BOX
20 µh Coil (49 turns No. 30 enamelled wire close-wound on a ½" diameter bakelite or polystyrene tube. Winding length approx. ½")
Binding post terminals for connection to signal generator output
Binding posts for connection to ANTENNA and GROUND terminals of receiver under test
GROUND
GROUND
400 µµfd Midget mica
400-ohm, ½ watt carbon

Fig. 1.

this manner may be checked against an oscillator which has such a calibration.

Audio Oscillator. This instrument must cover the frequency range 50 to 10,000 cycles and must have a continuously variable output attenuator. The maximum output voltage need not exceed 2 to 5 volts r. m. s. The output signal should be low in distortion. Resistance - capacitance - tuned oscillators are well-suited to this application, since their distortion percentage usually runs quite low.

Vacuum-Tube Voltmeter. An a. c.-type instrument is needed for both audio and r. f. measurements. The maximum full-scale deflection need not be more than 100 volts r. m. s. The v. t. voltmeter must have high input impedance to prevent excessive loading of the r. f. and i. f. circuits, and must have a capacitor-isolated input circuit to block any d. c. component encountered in the circuit under test. Suitable service-type voltmeters include the Sylvania Type 134 Polymeter, McMurdo Silver "Vomax," and RCA Voltohmyst with external diode probe. Instruments of similar design also are satisfactory.

Dummy Antenna. A circuit diagram of the standard dummy antenna is given in Figure 1. The parts may be mounted on a sheet of insulating material, such as bakelite or polystyrene, and enclosed in a small metal box or can. Coaxial jacks and plugs may be used instead of the binding post terminals, if the builder desires.

Load Resistor. In several of the tests, the loudspeaker voice coil must be replaced with a resistor having a resistance value equal to the impedance of the voice coil. The wattage rating of this resistor must be at least twice the normal watts output of the amplifier stage feeding the speaker. Thus, with an amplifier output of 2 watts, the resistor should be rated at 5 watts.

Test Conditions

When making tests 7, 8, and 9, the signal from the r. f. test oscillator must be fed into the front end of the receiver. That is into the antenna terminals. When the receiver has been

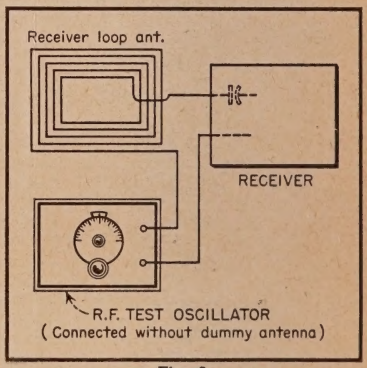

Fig. 2.

designed for connection to an external antenna, the dummy antenna (Figure 1) must be connected between the test oscillator and the input terminals of the receiver (see Figures 7 and 8). When the receiver is equipped with an

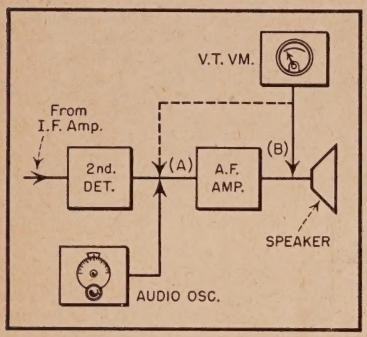

Fig. 3.

internal loop antenna only, one lead of the loop must be opened temporarily and the test oscillator output **(without the dummy antenna)** connected in series, as shown in Figure 2.

Unless instructed otherwise, all receiver tests must be made with a. v. c. and a. f. c. temporarily interrupted. The volume control(s) must be set for maximum volume. The tone control must be set to its center, or "mellow" position. The receiver must be detuned from any interfering signals picked up from the air.

Test Procedure

The block diagrams in Figures 3 to 8 inclusive show the connections of the test instruments to the various stages in a conventional a. m. superheterodyne receiver. These are the arrangements for making the ten tests listed earlier in this article under **Recommended Test Program.** The method of making the separate tests is explained below.

While we have shown a separate 1st detector and oscillator in the receiver, we are aware that many modern sets combine the two functions in a single converter stage. When working with a set containing a converter, treat the 1st detector in the diagrams as the detector section of the converter stage, and the separate oscillator in the diagrams as the oscillator section of the converter.

1. **Audio Gain and Sensitivity.** Set up the audio oscillator and v. t. voltmeter as shown in Figure 3. Connect the v. t. voltmeter to point B; that is, across the speaker voice coil. Connect the oscillator to the input of the audio channel. If there is more than one stage in the audio channel, connect the oscillator to the input of the **first** a. f. stage. Set the oscillator to 1000 cycles, and advance the oscillator output attenuator until the loudest **undistorted** signal is obtained in the speaker. Record the meter reading at this point as E_1. Transfer the meter to point A at the input of the audio channel and record the voltage at this point as E_1. To determine the amplifier gain, divide E_1 by E_2: E_1/E_2. Repeat the test at several other frequencies.

To determine audio sensitivity, use the arrangement shown in Figure 4. Increase the oscillator output until the rated output wattage is developed across load resistor R. (Watts can be determined from the v. t. voltmeter reading by dividing the square of the voltage reading by the load resistance: E^2/R.) When rated power output is obtained, transfer the meter to point A at the input of the audio channel

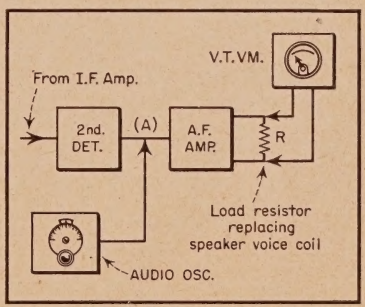

Fig. 4.

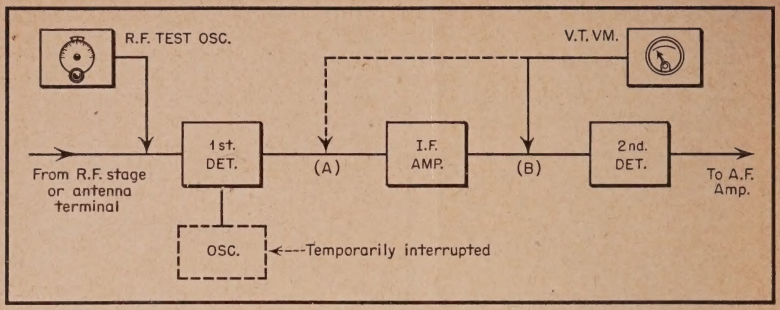

Fig. 5.

and read the input voltage. Power sensitivity is the ratio of the output power to the input voltage.

Repeat the test at several other frequencies, and at each setting of the tone control.

2. **Audio Power Output.** First, use the arrangement shown in Figure 3 to determine the value of input signal voltage which will give the loudest undistorted output signal. Then, without disturbing the oscillator or amplifier controls, replace the speaker with the load resistor (see Figure 4) and determine the audio output watts in the manner explained in the foregoing section **Audio Gain and Sensitivity.**

3. **Fidelity of Audio Channel.** Use the arrangement shown in Figure 4. Set the output of the audio oscillator to give rated amplifier power output at 1000 cycles. Note the voltmeter reading. Now, change the oscillator frequency in small steps from 1000 cycles down to 50, and from 1000 cycles up to 10,000, keeping the oscillator output voltage constant at all times (check the oscillator voltage by switching the meter temporarily to point A each time the frequency is changed). A high-fidelity amplifier will show very little output voltage change from the 1000-cycle voltage level as the frequency is varied from 100 to 10,000 cycles. Pronounced dips or peaks in the output voltage at various frequencies indicate poor frequency response which can be traced to defective or inferior components or to poor design.

Repeat the test at each setting of the tone control.

4. **I. F. Gain.** Use the arrangement shown in Figure 5. Connect the r. f. test oscillator to the 1st detector control grid. In some sets, it may be necessary to interrupt temporarily operation of the superhet oscillator. Connect the v. t. voltmeter to point B at the input of the 2nd detector. Set the oscillator to the intermediate frequency of the receiver, using either a modulated or unmodulated signal, and advance the output attenuator until a good, readable deflection of the meter is obtained. Record this reading as E_1. Read the microvolts output of the test oscillator from the calibrated attenuator and call this voltage E_2. Transfer the voltmeter to point A at the plate terminal of the 1st detector and increase the oscillator output further until the original voltmeter deflection (E_1) is obtained. Read the attenuator microvolts setting again and call this voltage E_3. The i. f. gain then may be determined by dividing E_3 by E_2: E_3/E_2.

Repeat the test for individual i. f. stages if there is suspicion that low gain is present in only one stage.

5. **I. F. Bandwidth.** Use the arrangement in Figure 5, with the v. t. voltmeter first at point B. Set the oscillator to the receiver intermediate frequency, using either a modulated or unmodulated signal. Advance the

oscillator output until a good, readable deflection (E) of the meter is obtained. Detune the oscillator below the intermediate frequency to the point where the meter deflection is barely readable on the lowest meter range. Read this

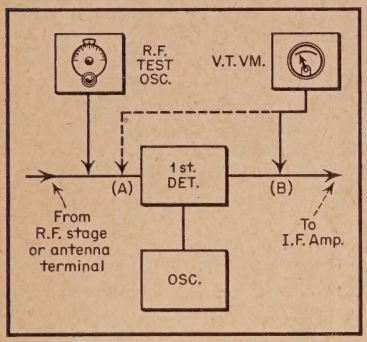

Fig. 6.

frequency (f_1) from the oscillator dial. Detune the oscillator above the intermediate frequency until the same reduced voltage point is reached, and read the corresponding frequency (f_2). A rough determination of i. f. bandwidth in kilocycles may be gained by subtracting f_1 from f_2: $f_1 - f_2$. A more exact overall picture is obtained, however, if the frequency is raised and lowered in small steps above and below the intermediate frequency, the corresponding voltages read, and the data used to plot a selectivity curve showing voltage vs. frequency, with the intermediate frequency at the center.

6. **Conversion Gain.** Use the arrangement shown in Figure 6. Set the oscillator to any clear frequency within the tuning range of the receiver and use either a modulated or unmodulated signal. Connect the v. t. voltmeter first to point B at the 1st i. f. control grid. Tune the receiver for maximum deflection of the meter and advance the test oscillator output to give a meter deflection of 0.05 to 0.1 volt r. m. s. At this point, record the microvolts setting of the attenuator as E_1. Transfer the voltmeter to point A at the control grid of the 1st detector and read the voltage at this point as E_2. Determine the conversion gain by dividing E_1 by E_2: E_1/E_2.

Repeat the test at several frequencies within the tuning range of the receiver.

7. **Selectivity.** Use the arrangement shown in Figure 7. Tune the receiver to a **modulated** signal from the test oscillator, and advance the oscillator output until full rated output watts are read across load resistor R (see Test 2). Detune the oscillator below the receiver dial setting until a point is reached at which the voltmeter deflection falls to zero. Read the fre-

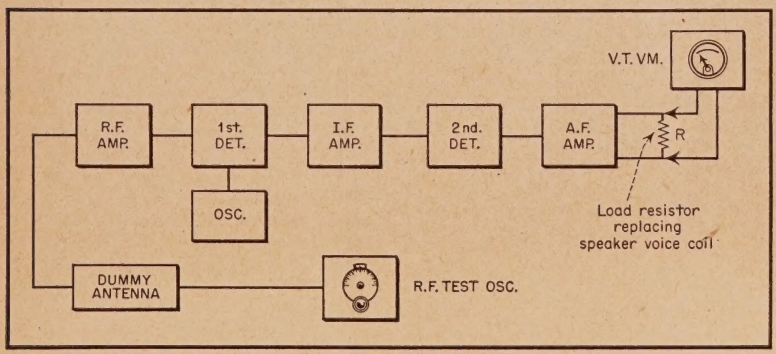

Fig. 7.

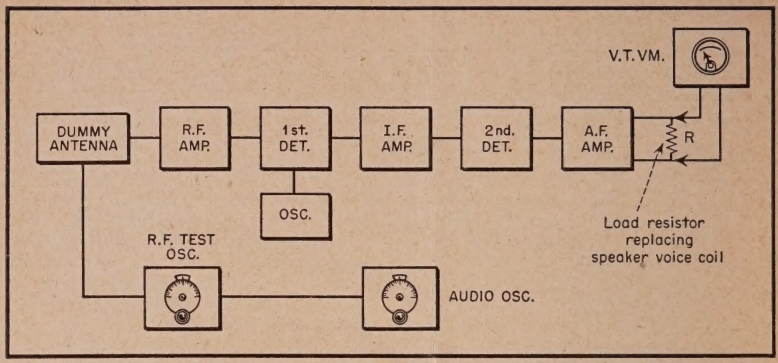

Fig. 8.

quency (f_1) at this point from the oscillator dial. Similarly, detune the oscillator above the receiver dial setting until the voltage again falls to zero, and read the corresponding frequency (f_2) from the oscillator dial. Points f_1 and f_2 are the closest frequencies which will not cause interference at the frequency to which the receiver dial is set. They accordingly indicate the front-end bandwidth. Thus, $f_2 - f_1$ gives an indication in kilocycles of the receiver selectivity. To obtain a more complete picture of selectivity, detune the oscillator above and below the receiver setting in equal small steps, record the corresponding output voltages, and plot a selectivity curve showing voltage vs. frequency.

Repeat the test at several frequencies within the tuning range of the receiver.

8. **Sensitivity.** Use the same arrangement, with a modulated signal, shown in Figure 7. Set the test oscillator signal to give full rated output watts, as read with the v. t. voltmeter (see Test 2), and at this point read the sensitivity directly in microvolts from the attenuator of the test oscillator.

Repeat the test at several frequencies within the tuning range of the receiver.

9. **Overall Fidelity.** Use the arrangement shown in Figure 8. Set the audio oscillator to 1000 cycles. Tune in the modulated signal with the receiver, and set the attenuator of the r. f. oscillator for full rated output watts as read with the v. t. voltmeter (see Test 2). Vary the audio oscillator frequency (keeping the audio output voltage constant at all times) and note any rise or fall in the v. t. voltmeter deflection. A high-fidelity receiver will show only small changes in output voltage as the modulating frequency is varied between 100 and 5000 cycles.

Repeat the test at several r. f. test oscillator frequencies within the receiver tuning range, and at each setting of the tone control.

10. **Noise or Hum Level.** Use the arrangement shown in Figure 3, except **do not use the audio oscillator in this test.** Connect the v. t. voltmeter to point B; that is, across the speaker voice coil. Short-circuit the antenna and ground terminals of the receiver to prevent pickup of signals or static. Note the voltmeter deflection which is due entirely to hum or noise. This signal voltage may be identified (that is, whether it is noise or hum or both) easily by listening to the speaker output. Repeat at each setting of the tone control. A significant figure is the ratio of this hum or noise voltage to the voltmeter deflection at full signal output.

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TRADE OR SELL—4-RCA-UV-201A; 1-216A; 1 LeClairton ampl. 28A; G.E. 15 tube 5-2000 mtrs, console; new tubes, 50/10% in 100 lots, all types. Want army carbine, transceivers complete and all wave oscillator. John Magnus, 9415 So. 55th Ave., Oak Lawn, Ill.

FOR SALE—BC-610 with speech amplifier modified for ten only, 813 driving 250th, good operating condition, $350. Or take good HT-9 and $135. Also HRO-5TA1, excellent condition, one year old, $185, and BC-342, good condition, $45. Adam Mayer, Box 425, Morehead City, N. C.

FOR SALE—12" Alnico "V" speaker in walnut wall baffle, $10; JT 30 crystal mike, table stand, 15' cable and connector, $8.50; Astatic E4P tone equalizer, $1.50; nylon 1J cartridge, $3.50. Richard Carpenter, Tama, Iowa.

FOR SALE—GI single speed recorder in cabinet, less amp., motor converted to dual speed, built in vol. indicator, two lead screws inside out, outside in. Also other radio parts, send for list. James Monsos, 4837 Harriet Ave., Minneapolis, Minn.

FOR SALE—Misc. radio parts, send for list. Les Didsbury, 1841 North Ave., Bridgeport 4, Conn.

SELL OR SWAP—H.O. model R.R. equip. Interurban car powered with Varney power truck, 5 assorted road, freight cars, track, and power supply pack, 110V ac to 12V dc, $60. A. De Paola, 900 Coney Island Ave., Brooklyn 18, N. Y.

WANTED—Two Rolo G 12 speakers. Have for sale: House trailer like new; 110V ac generator, less gas motor; boat, motors; etc. E. L. Thompson, P.O. Box 330, Fayetteville, Tenn.

FOR SALE—Calibrated Maxwell Bridge 1% scale, 100 micro-henry to 100 henry, $15. All inquires answered. G. Houck, Jr., 21 Barton Place, Port Chester, N. Y.

SALE OR TRADE—Radio parts, condensers, transformers, etc. Want V.O.M. meters, and BC696. D. T. Jones, 316 Kosciusko St., Nanticoke, Pa.

TRADE—Emerson rec., new, less cabinet; RCA Rider Chanalyst; Black and Decker 3/8" H. D. electric drill; BC 457. Want H. V. power transformer, fil. transformer, tubes, etc. C. E. Hicks, 178 Watson Circle S. E., Atlanta, Ga.

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FOR SALE—50L6, 35Z5, 3S4, 12SQ7, and 12SA7 radio tubes, 65 cents each, post paid. All new first quality tubes. Cash with order only. Jones Radio Co., Box 93 Douglasville, Pa.

FOR SALE—Western Field 16 ga., 6 shot, bolt action repeater, fired 3 rounds, $25; old radio chassis, several, with speakers and tubes, need only a little work, $3.50; beautiful console cabinet for G.E. model 76, $5; American-Bosch model 360 7 tube super-het., $12. V. A. Inkildson, 1505, N. 39th St., Milwaukee, Wis.

SELL OR TRADE—New .22, Hi-Standard, $43; M-1 Carbine, 150 rounds, $48; model 92, .32-20 Winchester, 50 rounds, $38; binoculars, French, 10 x 35, case, $40; Jap, 8 x 30, case, $27. Want high power rifle. George Needham, 998 Englewood, Cleveland Hts., Ohio.

FOR SALE—Kodak Reflex, with case, like new, $100; Ampro 8mm 750 watt projector with case, like new, $120; Revere 8mm camera, f2.5, with case, like new, $64. No trades, cash desired. D. L. Bickler, 2876 Jerome Ave., New York 58, N. Y.

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FOR SALE OR TRADE—Complete National Schools correspondence course, minus kits, $25. Want tube tester, or what have you in the way of test equip. Earl E. Sanders, 23811 Ward, Terrance, Calif.

FOR SALE—Flexifone 10 Sta. Master, 8 sub-stations, approx. 700' 3-cable intercomm, $175. Nels M. Berge, Dolliver, Iowa.

SWAP—Heavy duty amplifier, tube compliment 2-82, 4-6L6, 1-6N7. Want sig. gen, or what have you? Joseph Palmer, 786 E. 94th St., Brooklyn 12, N. Y.

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FOR SALE—Presto K-8 recorder; Shure "51" mike stand, chrome; pulpit stand; 10" record blanks; Wilcox-Gay recorder; Spanish-Hawaiian guitar, with case. Write for details. H. Dramen, 3945 Boundry St., San Diego, Calif.

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FOR SALE—Kodak Duo 620, model II, f3.5 lens, compur rapid shutter from 1 sec. to 1/500 sec., chrome finish, with lens shade and carrying case. Perfect condition. Louis Fialkoff, 143-48 41st Ave., Flushing, L. I., N. Y.

SELL OR TRADE—DeForest training course in radio, sound pictures, television, 1947, $25; 54 issues "Aeronautics" on flying, with rack, $5. Want 10 meter preselector. William Tietz, 1610 Mahan Ave., Bronx 61, New York City.

SELL OR TRADE—Vomax model 900, like new; R.C.P. model 805 tube and set tester in good condition. Also one wire recorder magazine, MX-303A/ANQ1 and companion recorder reproducer unit, built by Brush Mfg. Co. Want recorder and Mercury II universal camera. Charles S. Alexander, 209 Howard St., New London, Conn.

FOR SALE—Small accumulation of usable parts in chassis, speakers, tubes, books, one of each Radio News 1946-48, diagrams, and data. James Robedee, P.O. Box 39, Station V. Brooklyn 15, N. Y.

FOR SALE—50 back issues of QST between 1929 and 1940, 25 cents per copy;; driver and modulation transformer to mod. up to 300W, $5 the pair; dynamotor for BC-456-E and BC-458-A units, $2; pair Selsyns, $4. Or will swap. Gene Young, Greenhills 18, Ohio.

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FOR SALE—One Hickok 288X sig. gen. (new), $125 asking price. Edwin Gibbs, 53 North Rd., White Plains, N. Y.

SELL OR SWAP—AC Sylvania strobe flashlight outfit, perfect, used about 25 flashes. Sold complete for $200, will sell for $65 or what have you? Thomas Anthony, 272 Watson Ave., Lyndhurst, N. J.

SELL OR TRADE—BC-375-E transmitter, new and complete; Univex 3.5 lens; 1,000 watts 35mm motion picture projector; Crosley xervac, $50; No. 80 Ideal cast iron hot water heater, $15; Set of porcelain towel bars for bathroom, $7. Want test equip, recorder, tech. books, or what? Hansen Radio Service, 165 Silverbrook, Niles, Mich.

WANTED—I.F. transformer for Wards Air Lines Movie dial, 1936 model. Model No. unknown, serial No. on chassis, 0E979843. Tubes in set as follows: 4-6K7, 1-5Z4, 2-6C5, 2-6F6, 1-6C6, Movie Dial bulb, 6-8V. Tuning eye tube No. unknown. I will pay high price for I.F. described above. Snyder's Radio Service, 25 N. Center St., Sunbury Pa.

WANTED—Wiring diagram or instruction manual on Telrad 18-A frequency standard. Will pay reasonable price for information. Milton Seltzer, 233 N. 11th St., Pottsville, Pa.

FOR SALE—Test equipment 1E36 for 522, $25. Henry I. Griffiths. 39-82 65th Place, Woodside, L. I., N. Y.

FOR SALE—First quality radio tubes. Nos. 70L7, 50L6, 3S4, 12SK7, 35Z5, 69 cents each post paid in U. S. No order too small. Write for quantity prices. Jones Radio Company, Box 93, Douglassville, Pa.

WANTED—Good 16mm camera and sound projector, for cash or will trade radio parts, tubes, auto radios, portables, or any new table model radios. Raymond M. Zwickel, 1660 East 13 St., Brooklyn 29, N. Y.

SELL OR SWAP—One Genemotor, 6V input at 300MR 750V output; Brand new Riders' manual no. 15, covers from 1939 to 1941; Bendix automatic record changer, complete; Tubes, parts, and ham gear. Want 2 meter mobile and fixed gear, and Black and Decker 1/4" drill Jim D. Gysan, Myrtle Rd., Dennisport, Mass.

WANTED—Small cash register and adding machine, prefer electric. Will trade foreign rifles, souvenirs, radio parts, or pay cash. Ray E. Stultz, R. R. 5, Box 200A, Terre Haute, Indiana.

FOR SALE AND WANTED—Sell all standard makes of used radios, power packs, power transformers, excellent merchandise. Want brand new strips of plexiglass, 3/8" thick, by 9" x 5 1/2". Give price. Goldstone Radio, 1279 Sheridan Ave., Bronx 56, N. Y.

WANTED—From local radio-servicemen, auto radios in "as is" condition, any makes or models. Must be reasonable. Best Radio Shop, 3349 Fulton Road, Cleveland, Ohio.

EXCHANGE—Oil burner service or parts for radio equip. or parts. Norman Rothbard, 9814 Foster Ave., Brooklyn 12, N. Y.

FOR SALE—25 coin operated Tradios, slightly used, guaranteed insured for fire, theft. On location or without location. Sacrifice. S. Gross, 326 E. 96th St., Brooklyn 12, N. Y.

FOR SALE—Instructograph. Electric wound with 10 rolls of code, instruction booklet, oscillator unit, earphone, and key, ready to use, $26. Martin Rosenberg, 1212 Lincoln Place, Brooklyn 13, N. Y.

TRADE—Latest model E-200C Precision sig. gen. Want good 8mm movie projector. Will add cash if necessary. Dave Boord, 90-40 148 St. Jamaica 2, N. Y.

SELL OR TRADE—Triplett model 1501 tube tester and analyzer, $25 cash. Or trade for shotgun or rifle. Charles H. Royer, 391 Liberty St., Allentown, Pa.

SELL OR TRADE—NRI professional sig. gen. No. 88, $37; Radio City 802N set-tube tester, $53; Triplett O-50 DC millimeter, $3.50; Stancor tube tester transformer, $5. Like new excellent condition. J. Moy, Box 169, Canal St. Sta., New York 13, N. Y.

FOR SALE—Used tube tester, Ranger Examiner model 440, perfect condition. Has triplett adj. meter, mod. 223, with AC line voltage adj. First $10 money order takes it, prepaid. Williamson Radio Service, Cooper, Texas.

FOR SALE—1947 Lee DeForest radio and television course, complete with answers. Contains 100 chapters. R. F. Biordi, 1214 Eastbrook St., New Castle, Pa.

FOR SALE—HRO, Xstal phasing, S-meter, 4 bandspread type coils, 1.7mc-30mc, plus power supply, $115. BC-348P, converted to 110V ac, plus speaker, $58. Fred Singer, 8720 Cameron St., Silver Spring, Md.

SELL OR SWAP—Two hundred chemical test tubes for "what have you" in radio. Will answer all letters. Joe Horvath, Jr., 5810 Velma Ave., Parma 9, Ohio.

FOR SALE—Eleven Riders' Manuals, 5 thru 15, excellent condition, $95. c/o 15 Tuxedo Ave., New Hyde Park, N. Y.

TRADE—ATR inverter, input 6V dc, output 115V ac at 75w. For power pack, input 115V ac, output 6V dc at 10 or more amperes. Steve's Radio Service, Box 933, Terryville, Conn.

FOR SALE OR SWAP—7" Andrea television set, with magnifying glass, 35' coaxial cable, table, dipole antenna, in workiny condition, $130 or communication set. Martin Rosenberg, 1212 Lincoln Place, Brooklyn 13, N. Y.

FOR SALE—Navy rec., freq. 1.5-30. mc, 12" speaker, model "DAQ," $50; 8mm movie outfit, $50; Federal enlarger like new with 2 gross ea. of 8" x 10" and 11" x 14" photo paper, $65. Fred Simonian, 85 Shepard St., Lynn, Mass.

SWAP—Have Riders' 1 to 5 abridged, new, Will swap for vol. 9 or 11. Also have various meters and parts. What have you? c/o 6045 S. Halsted, Chicago 21, Ill.

TRADE—30 watt sound system, complete with mike and speaker; Taybern Electric Megaphone, type TPM-4, made for sig. corps, this is a portable sound system to be carried on your back. Trade both systems for a 5" or 7" T. V. set in working order. John Arnold, P.O. Box 84, Bluffs, Ill.

FOR SALE—Photographic interval timers (electronic) for use with enlargers. Brand new. Retail for $23.50 ea. Best offer. G. C. Wilson, Chatham, N. J.

FOR SALE—120V NBFM fone/cw xmitter, with a Sonar 680, VFX, rack mounted grey crackle finish, HQ-129X rcvr, Turner 22X mike. Excellent cond. Make offer. A. Rucco, 1630 Undercliff Ave., N. Y. 53, N. Y.

SELL OR TRADE—Riders' Manuals, 3, 4, 5, 8, 15; Riders' Record Changer Manual; Hallicrafters S41W. Want Leica and Contax cameras, tele. kit, or what have you? Joseph Sarnese, 532M. 53rd St., Philadelphia 31, Pa.

FOR SALE—Radiola 18 table model,beautiful cabinet, perfect condition, separate speaker, 7 tubes, $10. B. Sunshine, 85-17 - 167th St., Jamaica, L. I., N. Y.

SWAP—12 Bass Wurlitzer piano accordian with case for outboard motor. Joseph Schlaeger, 307½ - 23rd St., Brooklyn 15, N. Y.

SWAP—Winchester model 72 bolt action .22 cal. rifle. Peep sights, tubular magazine, like new; army sling, carrying case, cleaning rod and materials, targets, and ammunition. Swap for 35mm camera, Argus C-3 or equivalent. Julian Galack, 2310 Second Ave., New York 35, N. Y.

SELL OR SWAP—Royal 11" typewriter; A. B. Dick. mimeograph machine; Vibrotest unit, measures ac-dc 600V and 0-2,000, 0-200 megs; other meters. Also have a 1939 Dodge sedan for $500. M. Schwab, 5219 - 9th Ave., Brooklyn 20, N. Y.

FOR SALE—One Webster model 80 wire recorder with 7 spools of wire and wire conditioner, $130. Also model 670 supermeter, $20. All new. Reese Radio Service, Tracy, Minnesota.

FOR SALE—Ghiradis Radio Physics Course second edition, $3; Gorder, Hathaways Fundamentals of Radio, $1.25. Both in excellent condition. Dave Boord, 90-40 148 St., Jamaica 2, N. Y.

WANTED—Tobe, RCL,, or similar impedance bridge; Aerovox LC - checker wheatstone bridge or G. radio model 650A. Will pay cash, trade new parts, or test equip. Service Dept., c/o Couch's, P.O. Box 536, Gainesville, Fla.

FOR SALE—50 watt 10 tube amplifier with 4 inputs, $55; 12" Jensen PM12B speaker and trans., $25. B. Berman, 88 Stagg Walk, Brooklyn 6, N. Y.

TRADE—G.E. PR1 light meter; Elgin pocket stop watch; 2 cylinder airplane motor, with prop, etc.; 0-200 microamperes DC meter; pair of opera glasses. Want movie equip. or what have you? Ben's Radio Shop, 141 Summer Street, Lynn, Mass.

FOR SALE—New model 167B RCA sig. gen; model 912 Precision tube tester, up to date, testing late tubes. Both for $90. Berg's Radio Service, Pequot Lakes, Minn.

SALE OR TRADE—Fada model 5F50, ac-dc rec.; 2,000 I.R.C. B.T.A. insulated resistors; 30 radio books and manuals (value, $50). Want good SW rec.; 15-20W amplifier or PA system; 8 or 16mm projector, or make offer. Brownie Radio Service, 140 So. 4th St., Reading, Pa.

FOR SALE—One gasoline operated Cycl-ohm alternator. Starts from 6V bat. 0 to 150V 350 K.V.A. never been used, $125. Milam's Radio Service, 117 Lee St., Decatur. Ala.

FOR SALE—14 watt commercial amplifier, almost new with 12" PM speaker and baffle, single turntable and pickup arm. All for $40. N. Loeber, 6232 Hazeltine Ave., Van Nuys, Calif.

FOR SALE—Model 900 Vomax, just overhauled. $40 or best offer. Also table model French radio, 2 bands, needs a set of filters, $20 or best offer. Jack Marley, Box 713, Bedford, Iowa.

FOR SALE—Radio tubes, liberal discounts, known brands, any type shipped C.O.D. We pay postage. Messenger Radio Lab., 16 Rockhill Street, Foxboro, Mass.

FOR SALE—Complete file of QST's in excellent condition, 1931-1941, $50 FOB Berkeley. Willet Parry, 1423 Arch St., Berkeley 8, California.

WANTED—Good portable typewriter. Will pay cash or trade popular makes of electric motors, radios, modern appliances, or electrical equip. Supreme Electric Co., 1335 Butternut St., Detroit 16, Mich.

FOR SALE—Portable receiver, BC-728-A, police, shortwave, marine, telephone, 75 meter ham band, fire dept. Limited quantity. Carrs Radio Center, 17 Kelley Sq. Worcester 4 Mass.

WANTED—Will buy any model or make used radio sets. Send full information on all sets. Snyder's Radio Service, 25 N. Center St., Sunbury, Pa.

SALE OR TRADE—Sam's Photofact folders, 1 to 10 in binder; 3-way portable radio, vibrator 6V table model; Philco table model, long and short wave. All items in good condition. What have you? E. O. Norman, 2021 N. Houston, Fort Worth 6, Texas.

FOR SALE—Sterlings Radio Manual, $3; Ghirardi's Radio Physics Course, $2.75; Radio Service Course, $2; N.R.I. sig. tracer, $45; Vibroplex bug.$15. Charles Tucci. 47-11 98th St., Corona, N. Y.

SALE OR SWAP—Bantam grinder, new condition, plus $35 accessories, wheels, burrs, etc. Also 5 to 700 foreign stamps sorted. Swap for good sig. gen. sig. tracer or parts. Sell for $25. Glen L. Smack, 117 E. Chestnut St., Salisbury. Maryland.

TRADE—Crystaliner sig. gen., good condition for E-200 generator, or Superior model 650. All mail answered. J. C. Payne, Route 3, Box 468, Gadsden, Ala.

WANTED—Battery-electric switch for Fada model P-70 series (part No. 45-122) urgent. Rudy's Radio Center, 222 Putnam St., Manchester, N. H.

WANTED—FM tuner, small receiver such as EC-3-S41 Hallicrafters. Have flasha-call intercom or cash. Alfred Freitag, 1437 Patapsco St., Baltimore 30, Md.

WANTED—A set of schematic and pictorial diagrams of any standard amplifier for magnetic tape recording and play-back. State price. Antonio Joaquim, 116 Franklin St., Belleville 7, N. J.

TRADE—Supreme model 385 automatic tube tester, analyzer and multimeter for good sig. gen., Riders' Manuals or $25 cash. Albert J. Lee, 428 Bunker Hill St., Charlestown 29, Mass.

WANTED—Electronic design vacuum tube voltmeter ohmmeter, model 100. Will trade Rider Chanalyst and test leads and $60 difference. Meter must be good with ediprobe and operating instructions. Ellison Radio Service, Centertown, Ky.

SWAP—One complete radio compass with navigators instrument, loop antenna, and remote control panel for modern sig. gen. or tube and set checker. No junk. E. G. Schwartz, 134 Weber St., Havre De Grace, Md.

FOR SALE OR TRADE—2 variable voltage auto transformers, 0-125 ac, 15 amphere capacity. Paul Rumbol, 57 North High St., Greenville, Pa.

FOR SALE—The first 32 issues of Howard Sam's Photofact Folders. Charles D. Wagner Sr. 217 So. 16th St., Reading, Pa.

SELL OR SWAP—BC-312 rec. with power supply operating on 110V ac. Need test equip., or 8mm camera or projector. What's your offer? All letters answered. Alfonse L. Pinal, 14 Pleasant Ave., Clifton, N. J.

FOR SALE—Three BC-222 walkie-talkies with handsets, less tubes, batteries, and antenna. $15 each plus postage. Russell Boshart, Box 151, Olds, Iowa.

FOR SALE—R.C.P. portable tube and set tester, model 802N, in blond maple carrying case. Tests all tubes, in good condition with test leads, instructions, and tube chart, $45. Ted Pelczar, 12 Ferry St., No. Andover, Mass.

FOR SALE—RME Model LF-90 low freq. converter, $22.50; RCP model 702 sig. gen., with modulation, $20; Solar model QC-1-60 condenser checker,$15. Or sell all three for $50. Frank A. Law, Box 373, Loomis, California.

FOR SALE—Rimco dynamic sig. tracer in good operating condition, complete with new probe and cable fittings. Only best cash offer considered. Joe Wunderlich, 236 W. Brooks, Galesburg, Ill.

FOR SALE—R.C.A. Manuals volume 1 and 2, covering all sets from 1927-1942, $8. Also one army surplus automatic telegraph key made by Rotoplex, $5. Wesley Fowler, 264 E. Main St., Avon, Mass.

SWAP—A 32-20 French revolver for a VOM or UTUM, or what have you? Edward Druelinger, 1713 Robinson St., South Bend, Ind.

FOR SALE—Silver model 800 U.H.F. rec. 2 and 1¼ meter amateur bands, also the 152-162mc. police band. AM-FM, almost new. Complete. Make offer. Ross Hazelwood, 4402 Woodmere St., Jacksonville 5, Fla.

SELL OR TRADE—Fada model (48-K.W.) brand new tubes, beautiful cabinet, in good condition. Or swap for a vacuum tube volt ohm meter. George Warshower, 586 Reinsen Ave., Brooklyn, N. Y.

SELL OR TRADE—Abbot TR4 for 2 meters; BC-348 converted; parts for AW rig., with PP807's in final, also power supply; older type National 10 meter converter. Want receiver to cover 10 meter band. Prefer local deal. J. Cicciarella, 51 Chestnut St., Wakefield, Mass.

FOR SALE OR SWAP—McMurdo 701 transmitter, supply, spare parts, $40; Bud V.F.O.-21, extra coils, $35; RME 45, $100; HQ 129X, new, $135; Turner 99 mike, $13. Prices F.O.B. Miami. E. Kruse, 1526 Meridan Ave., Miami Beach, Fla.

FOR SALE—New Electronic and Instrument model B-4S battery operated sig. gen. Complete with test lead, batteries and instructions, $25 F.O.B. Walter Campbell, York Beach, Maine.

FOR SALE—300 watt xmitter, 4 decked "filing cabinet" type. Consists of xmitter, built-in rcvr, modulator, power supply, complete station with instruction manual, ECO 40-80 meters, tubes. $450 FOB. G. M. Dewey, Jr., 18 Pope St., Quincy 71, Mass.

FOR SALE—Navy TBY4 high freq. portable transmitter-receiver, 28 to 80mcs., $27.50. Also 250 QST magazines. Make offer. T. E. Olson, 3017 NE 31st Ave., Portland, Ore.

FOR SALE—Large assortment of electrolytic tubular and variable condensers; receiving and transmitting tubes; 14 types of meters. Write for complete list. Merl Hurry, 109½ Hanover St., Mankato, Minn.

FOR SALE—12" Transvision television rec. Used only 5 months, in good working order, with 12 TV channels, complete with antenna and cabinet, $350. Stanley Schneider, 1041 Findlay Ave., N.Y.C. 56, N. Y.

FOR SALE—Erwood dual post automatic record changer in cabinet. For wireless or hookup direct to radio, $20. Irvin D. Redman, 974 Park Place, Brooklyn 13, N. Y.

SWAP—Brand new Sola constant voltage transformer. Primary 95 to 125 volts, secondary 115 volts at 2.18 amps. Volt amperes 250. What have you? All inquiries answered. S. M. Hopper, 91 Bedford St., N. Y. 14, N. Y.

FOR SALE—Precision E-200 sig. gen., A-1 condition, $45. Masco 25 watt amplifier, 2 mike inputs, 1 phono input, table top phono, 2 12" speakers in baffles, all in A-1 condition, $75. Lester Schneider, 1315 West 7th St., Brooklyn 4, N. Y.

FOR SALE—High quality custom built true fidelity public address and recording amplifier system. 35 watt pre amp 5 low channels, including U.T.C. 3A equalizer. Reasonable. Otto Fichtman, 556 West 156th Street, N. Y. C. 32, N. Y.

SELL OR TRADE—Weston model 777 tube checker; new astatic T-3 mike; 2 new hand wound portable phonographs; 2 new Time Saver pressure cookers. Want Precision E-200 sig. gen.; 16mm projector; heavy duty ¼" electric drill. Charles Kramer, 178 East 57th St., Brooklyn 3, N. Y.

FOR SALE—Instructograph code machine with course. 115V ac model, including 10 double perforated tapes, nearly new, $25 F.O.B. Harry Farber, Country Club Heights, Elsinore, Calif.

FOR SALE—National FB7XA with 20-40-80 meter bandspread coils and National power supply, $25. No changes made, original wiring. Henry Mohr, 27 No. Jefferson St., Allentown, Pa.

FOR SALE—One 5 month old National 2-40D rec. and speaker. Also Harvey-Wells TBS-50 xmitter and home-built power supply. Excellent condition. Make offer. Harold Schwartz, 123 Bragaw Ave., Newark, N. J.

FOR SALE—Dumont 274 5" oscilloscope. Unused, sealed in original carton. Will sell for $105 cash. S. E. Zdeb, 68 School St., Chicopee, Mass.

SELL OR TRADE—Supreme 385 automatic set and tube tester, and Supreme sig. gen. model 189. Both excellent condition. $40 or trade for high power binoculars. Also have parts testers, manuals etc., for sale. Write for list. S. J. Garbinski, 108½ - 9th Ave., Newark 7, N. J.

FOR SALE—1B4T, 1B5, 2B7, 1H4, 6A4, 6ET, 6Y6, 12A8, 33, 49, 53, 79, 85, 89, brand new in cartons. Your choice $1 postpaid. J. H. Ellis, P.O. Box 63, Vermilion, Ohio.

FOR SALE—Exacta B with 2.8 tessar, A-1 condition, leather gadget bag, 5 filters, Bantam adaptor, sun shade. Or will exchange for television set. Morris Henner, 183 Ocean Parkway, Brooklyn, N. Y.

FOR SALE OR TRADE—High speed drills, 1/16" to 1/2" by 64ths, brand new set, $17.50. Also other tools and car heater. Trade for 1/4" or 3/8" electric drill or set of letter drills. William F. Haywood, 11-58 49th Ave., Long Island City, N. Y.

FOR SALE—1947 N.R.I. course books for $7; C-D Bn. capacitor bridge, $10; 1948 Heathkil sig. gen., $20. All in good condition. William Strella, 537 William St., Fall River, Mass.

SALE OR TRADE—Two WL-579B rectifier tubes, 20,000 volts peak inverse voltage. Make offer. M. Gottlieb, 1745 Fulton Ave., New York 57, N. Y.

FOR SALE—New standard brand tubes at 50% off list. Also have other parts at attractive prices. C. D. DeMunbrun, 1504 Hayes, Muskogee, Oklahoma.

FOR SALE—5 tube amplifier, complete with PM speaker in baffle, crystal mike, and phono recorder with playback. (Meissner recorder) Want test equip. or what have you? Henry Bollmann, 101 Oak St., R.D. 4, Somerville, N. J.

WANTED—Address of Louis C. Davis, was radio service man at Albany, Ga. G. W. Denchler, 1510 Monroe St., Omaha 7, Nebraska.

FOR SALE—Heath VTVM 1,000 volts ac-dc, 1,000 meg ohms, $25; electronic measurements VOM 101A, $15. Both in excellent condition with test leads. Also Hallicrafters S-38, very good condition, $38. H. Sambursky, 1668 Vyse Ave., Bronx 60, N. Y.

WANTED—Schematics for ASB-7 radar indicator unit. Also want Philco 025 sig. gen. John A. Williams, Sedalia, Colorado.

FOR SALE—Motorola television set, 7" with magnifier, like new, all channels, $135; Sparx sig. tracer, like new, $25; Webster 56 changer, $20. Terms, COD Prepaid. H. Angerman, 130 Liverpool Ave., Egg Harbor, N. J.

FOR SALE OR TRADE—100 watt input FM transmitter, well built, neat, complete with all power supplies and VFO all in one unit; plus Turner 33 dynamic. T. C. Fratia, Paxton, Ill.

SWAP—Sixty 1 watt I.R.C. carbon resistors, 10% tolerance. All brand new, no two alike. What have you? Joseph Balchunis, 2826 Winton St., Philadelphia 45, Pa.

FOR SALE—West-House motor generator set. AC motor, ¼hp, 110-120 volts, 60 cycles, 3,450 rpm. DC generator, 350-500 volts, 2 amps, 100 watts, like new, $50. Also early editions Radio magazines, old tubes, etc. Send for list. George D. Bowers, 604 Scarborough Ave., Rehoboth Beach, Del.

WANTED—Projector for 35mm Kodachrome slides. Must be in good order. Joseph McCracken, 5440 Trinity St., Philadelphia 43, Pa.

FOR SALE—Motorola universal fit auto radio, good condition, $35; ¼ hp G.E. 110V 60cycle motor, $12; good used RCA Riders Chanalyst cables, $1.50 ea.; Motorola 7½" electro dynamic auto radio speaker, $3. Paul Capito, 637 W. 21st St., Erie, Pa.

SELL OR TRADE—Complete National Schools Radio course; Webster 25 watt amplifier, 6 and 110 volt built-in turntable; 35 watt Grey amplifier, complete with mike, 2 12" PM speakers and cases. Priced right. Want Riders' Manuals 7 - 14. Radio Service Shop, 130 Broadway, Hornell, N. Y.

FOR SALE—Used radio tubes, 10 cents to 25 cents each postpaid. Also some new refrigeration fittings, all brass at one half wholesale price. Clifford Stout, 2241 E. Broadway, Muskegon, Mich.

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